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Neurobiology

Artificial vision in the spotlight

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Vision is considered among our most valuable senses. For many, it is taken for granted. Tackling the challenge facing visually impaired individuals may now be possible with new advances in research. Let's shed some light on the field of artificial vision.

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Out of sight - out of mind, as they say. Or maybe not? This can be an intriguing question for a neuroscientist today. For our eyes, everyday life is nothing more than light. The train ticket you bought, the person you chatted with, the article you are reading now, are all just light reaching your retina.

What follows next is a sort of relay race. As the light hits the retina, it transforms specific molecules, thus producing electrical signals. These signals are picked up by the optic nerves and transferred to the back of our brain, where the visual cortex is. The brain analyses this information and translates it, giving us information about our surroundings. In this example, the electric trigger comes from an external source - the light around us. However, this is not the only way. In a recently published study researchers triggered the visual cortex of monkeys using electrodes, to make them perceive an image, or more accurately, a dot of light.

You may have noticed that when you look at a bright spot for a moment and then turn your eyes elsewhere, some dots of light appear in your vision. These dots of light, which can vary in color and size, are called phosphenes. They can be created in one's vision using electrodes targeting the visual cortex. The goal of this study is to use phosphenes to create more complex images. If these can be created accurately using electrical pulses on the brain, these little dots can become a solution for people with impaired vision.

Firstly, researchers implanted tiny electrodes into the visual cortex of two monkeys with normal vision. The goal was to create simple shapes, motions, or letters using phosphenes generated by the electrodes. Using an implanted electrode allows researchers to target a precise area of the brain and activate specific neurons, thus creating a clear image. By contrast, previous studies using electrodes placed on the surface of the brain, which lack such precision, produced large phosphenes, and thus lower resolution images.

The next challenge was working with monkeys: how can they report what they see? The answer is eye movement. Researchers launched two versions of the same experiment. In the first version, they electrically stimulated the brain to create phosphenes that appear at a specific area of the monkeys' visual field. In the second version, a similar-looking dot was projected onto a screen, positioned to appear in the same area of the monkey's visual field. If the experiment succeeds, the monkeys will move their eyes towards the same direction in both cases.

Using this setup, researchers demonstrated that monkeys could perceive different shapes and a direction of motion. After that, phosphenes were assembled in the form of letters. However, the monkeys could not distinguish between different letters.

Next, the researchers addressed a challenge that comes often when working with living beings. As the monkeys get tired during the experiment, a dot of light may slip their attention and go unnoticed - which can skew our understanding of their response. To overcome this, the research team found a way to record the response from monkeys, which does not rely only on their eye movements. Instead, they recorded the activity of neurons in another part of their brain, that are activated when the phosphenes are appearing in the monkeys vision.

These are important insights for the field. Yet, a lot still needs to be done before an intracortical device can help individuals with compromised vision. Despite the obstacles, the technological advances in electronics, alongside the scientific progress in this field, are the sharpest tools we can use for building the future of artificial vision.